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A
FAIR, CANDID, AND IMPARTIAL
STATE OF THE CASE
BETWEEN
Sir Iſaac Newton and *Mr. Hutchinſon.*

IN WHICH IS SHEWN

How far a SYSTEM of PHYSICS is capable of Mathematical Demonſtration—How far Sir ISAAC'S, as ſuch a Syſtem, has that Demonſtration—and, conſequently, what regard Mr. HUTCHINSON'S Claim may deſerve to have paid to it.

By GEORGE HORNE, A. M.

FELLOW OF MAGDALEN COLLEGE IN OXFORD, AND AFTERWARDS LORD BISHOP OF NORWICH.

He that anſwereth a matter before he heareth it, it is folly and ſhame unto him. PROV. XVIII. 13.

Non ſpecies virium & qualitates phyſicas, ſed quantitates & proportiones mathematicas expendens. NEWT. PRINCIP. p. 172.

I attempt not to detract from the praiſe which is juſtly due to thoſe who by diligent and conſtant obſervations and calculations have aſcertained the proportions and meaſures of the motions of bodies, but only to diſcover the cauſes of thoſe motions, which I think none ever pretended to ſhew. HUTCH. vol. XI. p. 226.

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BRITISH MUSEUM

A

Fair, Candid, and Impartial

STATE OF THE CASE, &c.

THE attention of the learned world being at preſent wholly turned on phyſical ſpeculations and enquiries, ſome embracing the method of philoſophiſing eſtabliſhed by Sir ISAAC NEWTON, and others as warmly ſtanding up for the opinions of Mr. HUTCHINSON, the public will not, I flatter myſelf, diſlike to have a fair, candid, and impartial ſtate of the caſe between theſe two authors laid before them, that ſo every one, ſeeing what the tenets of both are, and wherein they differ, may be enabled, with very little trouble, to judge and determine for himſelf. Nor can this be thought a uſeleſs undertaking by any one who conſiders the high opinion entertained from the remoteſt antiquity, by the good and great, of the importance of phyſical knowlege, and the benefits accruing from a right underſtanding of it to the ſons of men; the brighteſt parts and ableſt pens in all ages and nations having ever been exerciſed and employed in the reſearches of nature. The diligent application to the ſtudy of this ſcience, of late years more than ever, amongſt the moderns, and their unwearied endeavours to improve and enrich it with new obſervations and experiments, ſufficiently ſhew how much they are perſuaded of its ſuperior worth and excellence: ſo that mankind, however they may have differed in their opinions concerning the various and almoſt numberleſs ſchemes and hypotheſes that have been offered to the world, to explain and account for the operations of nature, yet in this are unanimous, that the ſtudy and contemplation of them are well worthy the time and thoughts of every one who has them to ſpare. And very right and fit it is that they ſhould be ſo, ſince he, who beſt knows the wants of his creature man, has thought proper, in infinite wiſdom, to begin his gracious revelation to us with a deſcription and explanation of the works of his almighty power, in the creation and formation of the world. Nor does he teach and inſtruct us in *the inviſible things* of himſelf, otherwiſe than through the medium of *the things that are made*; and therefore he firſt gave us the knowlege of the natural world, that through it we might attain to that of the ſpiritual. The foot of the ladder was let down to earth, that we thereon might aſcend to heaven. The true knowlege of nature then being a thing of ſo high and momentous a concern to us, a diſquiſition into it, when made with modeſty and humility, as all ſuch ought to be made, can at no time be unacceptable to thoſe who have any regard for true ſcience. But it will, I may preſume to hope, be more particularly ſo at this time, when the ſurpriſing phænomena of electricity, and many other very nice experimental diſcoveries lately made, ſeem greatly to have awakened and excited the curioſity and attention of mankind, and to promiſe a more juſt and ſatisfactory account of the cauſe of motion, and agency of nature, than the penetration of philoſophers has yet been able to aſſign. Philoſophy, we know, is a ſcience capable of improvement; and, as it is a public treaſury, open to and collected for the uſe of all, ſyſtematic views and private intereſts ſhould have no place here, but general encouragement ſhould be given to any the meaneſt contributor who can in any wiſe enrich it, though it be but with a mite. Mine pretends not to be more; but, ſuch as it is, I offer it the reader, I am ſure, with an humble heart, and beg he will not let it paſs with him or his friends for ſterling, if it appears upon the ſtricteſt trial not to be ſo.

The NEWTONIAN ſyſtem has now been in poſſeſſion of the chair for ſome years: but there have appeared, ſince its firſt publication, ſome treatiſes on philoſophical ſubjects by a very curious and inquiſitive perſon (as * Mr. WHISTON juſtly calls him) Mr. HUTCHINSON, who thought that by the light which revelation afforded him, compared with his own obſervations, he ſaw farther into the conſtitution of the univerſe, and the operations carried on in it, than Sir ISAAC had done. As the publication of theſe pieces was at a time when Sir ISAAC had

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* *The longitude and latitude found, &c.*

ſet the learned on a warm purſuit after phyſical knowlege, and as, by their titles, they certainly promiſed and pretended to ſomething very great and important, as well as new and ſurpriſing, one ſhould have thought they would have been immediately canvaſſed, and thoroughly ſifted, that ſo the wheat might have been ſeparated from the chaff, and gathered into the common granary. But experience has ſhewn us this was not the caſe. Their claim has been ſlighted and neglected, and they have been greatly diſcouraged and oppoſed; and what is amazing, and almoſt incredible, in ſo curious and inquiſitive an age, it has been chiefly, if not altogether, either by thoſe who, through ſome prejudices, (incident alas to the greateſt and beſt of men!) have judged and determined without reading or hearing the merits of the cauſe, or by thoſe whoſe indolence was content to ſuffer ſuch to judge and determine for them. But their claim has lately been revived again, and a ſecond hearing demanded (if the firſt could be called a hearing) before ſentence is paſſed. A new edition of Mr. HUTCHINSON's works, which were before grown ſcarce and out of print, has put them into every body's hands. Many perſons of leiſure and curioſity, having carefully peruſed, and given them a fair and impartial examination, have highly approved of his general plan, without thinking themſelves obliged, upon that account, to ſubmit implicitly to him in every particular etymology, or interpretation, as infallible. And this they have done, not out of any ſuperſtitious bigotry, deſire of novelty, or love of paradox and ſyſtem, (to which no people have a more mortal averſion) but a ſober, ſerious, and rational conviction of its truth and rectitude, the reaſons of which they have been always ready to give, either in converſation or writing, could they but meet with common candour and civility. To move the court that theſe may be granted them till the evidence be produced, and the cauſe determined as truth and juſtice ſhall require, is the deſign of the preſent undertaking.

One great reaſon why Mr. HUTCHINSON's diſcoveries have not been received, at leaſt examined to ſee whether they deſerve it or no, I am fully perſuaded, upon a thorough conſideration of the matter, is this—It has been an opinion for ſome time entertained, that Sir ISAAC's philoſophy is abſolutely certain and infallible, becauſe it is founded upon and proved by mathematical principles and demonſtrations, which are in themſelves univerſally allowed to be ſo. Now, if by an enquiry into the nature, uſe, and application of mathematics, it could be ſhewn what thoſe things are which they are capable of proving, and then from Sir ISAAC's works what he himſelf ſays he has proved by them, it would lay open the ſtate of the caſe, with regard to the preſent ſituation of affairs in the philoſophical world, and make it perfectly clear and intelligible to the very meaneſt capacity; as it would ſhew at one view, what room there is for any farther improvements, and, conſequently, what regard the claim of Mr. HUTCHINSON, or any other author who writes after Sir ISAAC, may deſerve to have paid it. How far this is done in the following pages muſt be left to the judgment of my readers, when they have conſidered the reaſoning in them. If any perſon, when he has done that, ſhall think it worth his while to condeſcend ſo far as to point out my errors to me, in a ſpirit of candour and good manners, (as I hope it will be allowed I have treated all thoſe whom I have had occaſion to mention in the courſe of this undertaking) I ſhall eſteem him my greateſt benefactor, nor fail to make him my public acknowlegements. And one thing I can ſincerely promiſe him for his encouragement, that he ſhall find it is no ſort of difficulty or hardſhip to me to own myſelf miſtaken.—This premiſed, I proceed to the enquiry.

AND here, as it is the beſt way, before we enter upon any diſquiſition, to have the terms defined, and the ſenſe we uſe them in fully aſcertained, that ſo there may be no miſtake or miſunderſtanding about them, I ſhall begin with a definition of *phyſics* and *mathematics*. The ſcience of *phyſics* then, I apprehend, as appears by its very name, is that which teaches us to underſtand the operations of *nature*, i. e. how matter acts upon matter, and produces all thoſe various effects, or phænomena, which we every day ſee produced in the world. *Mathematics*, on the other hand, treat of magnitude and numbers, inſtructing us how to meaſure, eſtimate, and compute the different diſtances, magnitudes, and motions of bodies, with reſpect to one another,

another*. From theſe definitions, the widely different nature and genius of each ſcience, I think, plainly appears. The one is converſant about cauſes, the other, effects: the one finds out the agents which produce motion, the other ſettles and adjuſts the proportions of the powers of thoſe agents: the one ſhews what it is that acts upon all bodies, the other, the mode and degree of its acting upon different bodies in different circumſtances. To diſcover the properties of matter, what matter is agent and what patient, how the one is ſupported in its agency, and how the other is diſpoſed and contrived to receive that agency, is the buſineſs of phyſics. When this is once ſettled and eſtabliſhed, then let mathematics have their full play, and they will appear in their true beauty and excellency; their uſe will be as great as their moſt ſanguine admirers contend for, and the reſult of their application firm and laſting. Very entertaining and inſtructive will it be, by making experiments with them, to obſerve the different effects that the agents and patients ſo fitted and contrived produce, in various caſes and circumſtances, upon different parcels and quantities of matter, differently ſituated and diſpoſed, by their various and different aſſociations and combinations. We ſhall every day be diving farther into the minutiæ and arcana of nature, and proving the exiſtence and operation of our pre-eſtabliſhed, general, phyſical cauſes, by ſhewing their agency and the manner of it in particular inſtances. But ſhould any man ſet himſelf to interpret and explain the ænigmata in the book of nature, without having firſt ſome general key to it, or venture himſelf in her labyrinth, forgetting to take a clue with him that would lead him ſafe through its numberleſs turnings and windings, I much fear he would ſoon find himſelf ſtrangely puzzled and bewildered, and be but too much the occaſion of mirth and entertainment for the raſhneſs and folly of his attempt, to thoſe who, having wiſely before-hand provided themſelves with both, have been able, with very little trouble, to underſtand and find their way through them. The cauſes of nature are not to be diſcovered by mathematics, though her effects may be aſcertained by them. And was any one to attempt any thing of that kind—(Was he, for inſtance, to undertake to ſhew how fire burns by algebra, to explain the nature and operations of the ſun by trigonometry, or aſſign the cauſe of vegetation from the theory of conic ſections) he would, I ſuppoſe, and that very deſervedly, provoke the laughter and incur the contempt of all ranks and degrees of people: and yet to give a ſatisfactory account of all theſe things is the buſineſs of a *phyſical* writer. Nor is this all; but whoever attempts to gueſs at cauſes (for it can be called nothing better than gueſſing) merely from the ſuperficies and appearance of things that preſents itſelf in effects; whoever makes the miſtreſs to wait upon the handmaid, goes firſt to work with mathematics, and computes by obſervations and experiments the proportions of the motions of bodies in particular caſes, and then infers, by deduction from what he ſees only, the cauſes of thoſe motions, and that not in ſuch particular caſes alone, but makes the application general and univerſal, poſſibly may, and probably will, run into many ſtrange and fatal miſtakes, which, beſides obſtructing the path leading to the knowlege of the particular about which he makes them, will prevent his coming to the truth, almoſt in any point, while he retains them.—I will beg leave to ſet down in this place ſome of the errors which ſeem to me to flow naturally, and almoſt neceſſarily, from ſuch a conduct. And

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* The definitions given by CHAMBERS in his CYCLOPEDIA are to the ſame effect with thoſe here ſet down, though not expreſſed exactly in the ſame words:—" *Natural philoſophy*, otherwiſe called *phyſics*, is that ſcience " which conſiders *the powers of nature*, the *properties of* " *natural bodies*, and *their mutual action on one another*. " *Mathematics* is the ſcience of *quantity*, or a ſcience that " conſiders things as *computable*, or *meaſurable*."

First, as we judge in this caſe by appearances only, and ſee nothing but bodies moving, we may be very eaſily and naturally led to infer, that they move of themſelves by ſome inherent virtue, or move one another by ſuch virtues emitted: or elſe we may think that the Deity is ſubſtantially preſent with them, and moves them by his *immediate* influence. Either of which opinions will lead us—I know not whither.

Secondly, as when we have made all our obſervations and experiments upon an effect, if the cauſe ſhould happen to be inviſible and imperceptible to the ſenſes, we ſhall be left only to fancy and imagination, without any other guide, to gueſs at what we think will perform it, we may invent fifty imaginary ones, and every time miſs the true one; nor have we any criterion whereby to judge which is true, and which imaginary, becauſe we can make the mathematical laws and proportions of motion ſquare to the imaginary one as well as to the true one, and to one imaginary one as well as to another. They will be true in themſelves, whatever the cauſe be, and therefore can never demonſtrate whether the cauſe be ſo or no. Which conſideration alone, if it were carefully attended to, would, I humbly think, ſettle the queſtion at this time ſo neceſſary to be ſettled—How far a ſyſtem of phyſics is capable of mathematical demonſtration.

THIRDLY, as in this method of proceeding we draw a general concluſion from particular premiſes, that is, infer, from an experiment upon a ſmall parcel of matter, that the effect is the ſame in larger and more general operations, where there may be multitudes of circumſtances, to us unknown, to vary and alter the caſe, we muſt fall very ſhort. Every new phænomenon that appears, where the circumſtances of things are altered, will be quite different, and put us to our wit's end to account for; the conſequence of which is, that we muſt either aſſign it to a different cauſe from the former, in which caſe we ſhall have as many cauſes as phænomena, or we muſt aboliſh the firſt cauſe, and try if we cannot make both the effects ſquare to a new one, in which caſe we ſhall be changing our cauſes every day.

Fourthly, as the grand cauſes which produce and carry on all the motions and operations of the univerſe may happen to lie above and out of our reach, and we can, at beſt, reaſon only upon ſuch ſcanty pittances of them as are here within our reach, we may, by ſeeing and knowing ſo little of them, drop and lay them aſide, as not able to do the work they are appointed to do, eſtabliſh a ſet of falſe, non-entital, and imaginary ones, which we happen to think or fancy will do better, in the room of them, and ſo, by making every thing bend to them, not only have the miſery and mortification of being enſlaved to error, but, by precluding any farther enquiries in a different way from that eſtabliſhed, prevent the very poſſibility of ever arriving at truth.

As this is a point of ſome conſequence, I will beg leave farther to illuſtrate and explain my meaning by a familiar inſtance, which will ſet it in a clear light, and leave no room for any doubt about it, or, I hope, the truth of it. A perſon, who had never ſeen a machine of the kind before, happens to meet with a clock, and, upon looking attentively at it, perceives the hand to move round the dial-plate. Much ſurpriſed at this, and not able to imagine how a piece of inanimate inert matter ſhould have a power of motion in it, he goes to a friend of his, who, though an excellent mathematician, was ignorant of the nature of the machine, and deſires him to inform him how it was done. The caſe of inſtruments is produced, and to work he goes; and after ſome time tells him, that it appears from the niceſt and moſt accurate obſervations and experiments he can make, that the hand moves over the ſpace of an inch and a half in an hour, which amounts to exactly 18 inches in one day. Now this diſcovery, though the calculation might be perfectly true and juſt, could, I ſuppoſe, afford but very little ſatiſfaction to the enquiring friend, who wanted to know the cauſe and manner of the agency in this caſe. And yet, farther than this, I think, mathematics cannot go in the diſcovery of it. For, ſhould our gentleman, without any farther knowlege or enquiry, go to reaſon about the cauſe from what he had ſeen and obſerved only, would he not run directly into the miſtakes I have above ſuppoſed to be the natural conſequences of ſuch a proceeding? Let us ſee:—Firſt, as he ſaw nothing but the hand moving, and the dial-plate on which it moved, he would, he muſt, without any farther inſtruction, conclude, either that the hand moved itſelf, or that the dial-plate moved it. Secondly, if he had a fruitful imagination, he might make out fifty cauſes, by giving different names to theſe ſuppoſed occult powers in the hand and dial-plate, all in the ſame taſte, and terminating ultimately in the ſame end, and always be ſure to miſs the right. Nor could his calculations ever give him the leaſt aſſiſtance in diſcerning when he had the right. The hand would move over juſt the ſame ſpace in the ſame time, whether the cauſe of the motion was in itſelf, or in the dial-plate, or external to both. Thirdly, if he was to aſſign either of theſe as the cauſe of motion, not only in that particular machine, but deduce a general rule from it, that it muſt be ſo in all others, and obſerve the ſame rules of acting as it did there, the next machine he ſaw, where the ſituation of things was altered, and the movement as well as proportions different, would nonplus him. The ſame ſort of cauſe would not do here. He muſt either therefore excogitate a new ſpecies of it, acting by other laws and rules, and then he might have as many ſpecies as there are machines, or muſt quit that entirely, and aſſign another cauſe for both, and then he might change them every day. Fourthly, as the real and true cauſe was out of his reach, and he reaſoned only upon thoſe parts which appeared to him, the hand and the dial-plate, and ſettled his principles accordingly from them, thereby excluding all mechanical powers, reſolving it could not be done by any ſuch, only becauſe he ſaw no ſuch to do it, and could not conceive how there could be any, he would not only embrace and adopt a falſe ſcheme, but, by barring himſelf from any enquiries that way, utterly preclude himſelf from ever coming to the knowlege of the true.

Thus I have endeavoured to point out ſome of the inconveniences that may attend what may be called a mathematical method of philoſophizing, ſhould it ever be attempted. And now, that I may keep up to the definitions I ſet out with, I muſt beg the reader to indulge me, while I juſt hint, on the contrary, at the advantages reſulting to the humble and diligent enquirer, from a phyſical ratio of proceeding. And here the ſame inſtance, I believe, will very well ſerve our purpoſe. The part then of a phyſical ſpeculator, or true philoſopher, when he had ſeen the circular motion of the hand round the plate of a clock, would be, immediately to examine the ſubſtance the whole was made of, and the form and contrivance of its make. He would preſently ſee that it was all inert matter, no part of which could poſſibly move, unleſs it was moved by ſome other; and though indeed he could perceive no viſible cauſe of its motion, yet, as a great part of the clock, about the hand, was concealed from him, he would not determine that it moved itſelf, till he was certified what was there. If he could not get at this, he would enquire how the machine came in the place where he found it, who made it and put it together, and get the artiſt, if he was to be got, to unlock and ſhew him the mechaniſm of it; how by the weight of the incumbent maſſes of braſs, or lead, a ſtreſs and tenſion is laid upon the wheels, which are ſo diſpoſed as to act upon one another, and by that means on the hand, which has a communication (by him never perceived) through the dial-plate with them. He might then contemplate it with inexpreſſible pleaſure and ſatisfaction, obſerving the neatneſs and perfection of the machinery, how exactly and conſtantly every wheel performed the part to which it was adapted and deſigned, and the regularity and uniformity of the hand's motion produced thereby. When the artiſt has inſtructed him thus far, (and thus far he muſt be inſtructed before he pretends to reaſon upon the ſubject) if he has a mind to amuſe himſelf in making nice obſervations and experiments upon particular parts and actions of the machine, and, by applying the mathematics, to find out and ſettle the proportions the wheels bear to each other, and their different effects according to their poſition or number, he cannot do better. It will be a conſtant fund of inſtruction and entertainment to him: he will every day diſcover more and more the aptneſs and fitneſs of the cauſes made uſe of by the artiſt to produce the effects deſigned, and conſequently be continually ſeeing freſh reaſon to admire his admirable ſkill and contrivance*.

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* It may be proper to obſerve in this place, that I do not bring the inſtance of a *clock* as parallel to the *world* in all points, which it evidently is not, the one receiving its motion from ſomething external to itſelf, the other being (phyſically conſidered) a ſelf-moving machine; but thus far only, that the cauſe of motion in both is inviſible and imperceptible; and in this reſpect I apprehend they are exactly ſimilar.

Since I wrote this, a friend ſhewed me a parallel of this kind, drawn by the great and good Sir MATTHEW HALE, in his *Origination of mankind*; where he ſuppoſes a ſet of ancient philoſophers, of different ſects, who had in their walks found a curious *clock*, or *watch*, diſputing upon the cauſe of its motion, and endeavouring to account for it, each according to his reſpective hypotheſis; till the artiſt appears, and ſhews them how totally wide they all were of

Theſe are my ſentiments of the eſſential difference between phyſics and mathematics, and the true uſe and application of the latter to the former. I hope they will be found to be ſupported by right reaſon, and not wholly diſagreeable to the fitneſs of things. This only I know, that I offer them to the public becauſe they ſeem to me to be ſo, and ſhall be ready to withdraw them the moment they are found to be otherwiſe. They deſire only a candid and unprejudiced judgment, and are

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of the mark; for that he had made the machine, and put the parts of it together in ſuch a manner, as that the motion once given it ſhould continue, without the immediate application of his hand every moment to it. The uſe Sir MATTHEW makes of this is, to ſhew, as in a picture, the confuſed and vain ſpeculations of philoſophers about this ſyſtem of the univerſe, and the motions carried on in it, when God by MOSES has ſtruck dumb the wiſdom of the wiſeſt of them, and ſhewed *that* in one chapter, to diſcover which thouſands of volumes have been written and read in vain. The paſſage is too long to inſert here; but I muſt beg the favour of the reader to peruſe it at his leiſure, as I am certain it will amply reward his pains, and will, I hope, be ſome ſanction to what I have here ſaid upon the ſubject.—See *Origination of mankind*—ſect. iv. chap. 6. *ad init.* This paſſage is likewiſe quoted by Biſhop BURNET in his Life of Sir MATTHEW HALE, as an inſtance of his manner of illuſtrating ſubjects by ſimiles, or compariſons—p. 129.

equally prepared to ſtand or fall by its determination. But as a writer is nothing in this age without his paſſport of authorities, and as a love and fondneſs of ſingularity and novelty is what I ſhould be very ſorry to have imputed to me, I ſhall deſire to have counſel heard upon this point, that the reader may ſee, the poſitions advanced above are not the inveterate prejudices of a bigot, the diſtempered fumes of an over-heated imagination, or the mad ravings of an enthuſiaſtic brain. And I am much pleaſed to find, upon turning over that juſtly celebrated poem ANTI-LUCRETIUS, that I have an able advocate in the polite and learned author of it, who has expreſſed almoſt the ſame ſentiments upon the point in hand that I have done, but in ſo very widely different a manner, with that beauty, propriety, and elegance of language, that the reader, I am ſure, will excuſe me if I ſet down the paſſage at length. It is in the IVth Book. The learned Cardinal is diſcuſſing the caſe of a ſet of philoſophers in his time, who, it ſeems, had eſtabliſhed falſe cauſes, and then pretended to prove them true by mathematical calculations and demonſtrations—His words are as follows:

Nec redimit genus hoc vitii perfecta matheſis.
Scilicet illa modos tantum deſcribit agendi,
Naturam vero non inveſtigat agentis.
Cum fieri poſſit numeros det ut algebra rectos,
Abſurdo ad libitum poſito quaſi certius eſſet.
AT SOPHIÆ EST CAUSAS, NON TANTUM EFFECTA NOTARE:
DUX *veri ſophia eſt*; *ſophiæ* GERMANA *matheſis*;
Ambæ CONCORDEM *gaudent impendere curam*;
Utraque naturam complectitur, altera manca eſt.
Motum hunc ſi caſu *fieri, vel* amore *docerem*,
(Hæc habuere ſuos etenim commenta patronos)
Turbinis aut inſtar crepitantibus ire flagellis
Sidera percuſſa, & variâ vertigine volvi;
Si canerem aurigas illis aſſiſtere divos,
Credidit ut cæli plerumque ignara vetuſtas,
Et curſum inter ſe pactum ſervare regendo;
Si fretus Ptolemæo, operoſos orbibus orbes
Adjicerem, uſque novis cælum intricans Epicyclis;
LEGITIMOS POSSIM NUMEROS IMPLERE: *quid inde?*
VERACES NUMERI, MENDAX AT CAUSA SUBESSET. LIB. IV. V. 1082.

A clearer and nobler teſtimony cannot, I think, be wiſhed for, or deſired, nor can I ſee how any thing I have ſaid can be attacked, unleſs the Cardinal's reaſoning be firſt ſubverted. And I muſt confeſs, I ſhall not be afraid or aſhamed to fall with ſo polite a ſcholar, and perfect maſter of his ſubject, as every one who has read his book muſt acknowlege him to be. If there ſhould be any who will take upon them to ſay, that Cardinal POLIGNAC did not underſtand philoſophy, (though it becomes ſuch to prove what they aſſert, before they expect to be heard by men of ſenſe and learning) let them take the authority of one who did, amongſt their own countrymen. "Geome-
"try can be of little uſe in philoſophy till
"DATA are collected to build on; and Lord
"VERULAM has juſtly obſerved, *Matheſin*
"*philoſophiam naturalem* TERMINARE *de-*
"*bere, non* GENERARE, *aut* PROCREARE.
"It is the province of mathematics to put
"the LAST hand to phyſics, not to BEGET
"them." The learned and ingenious COLIN MACLAURIN, in his *Account of Sir* ISAAC NEWTON's *Diſcoveries*, p. 36.

But here I am very ſenſible I muſt ſtop. All this, I ſhall be told, ſtrikes directly at the NEWTONIAN philoſophy, which is profeſſedly mathematical, and goes upon the very plan I have been endeavouring to prove an erroneous one; ſo that I ſhall be in danger of having the candour I pretend to called in queſtion, and loſing all my readers, who will not care to be ſeen in the company of one who has falſified his honour, and not kept up to his promiſes and engagements. This is, indeed, a very material and powerful objection; and if I cannot get handſomely quit of it, to be ſure I may as well lay down my pen, and proceed no farther; which many, I know, according to the commonly received notions of the NEWTONIAN philoſophy, will think I ſhall certainly be obliged to do. But I hope, if it could be ſhewn—that Sir ISAAC NEWTON agrees with me entirely in the uſe and application of mathematics—that his deſign was only to aſcertain effects, and calculate proportions by them—that he uſed his terms as names only for effects—that he confeſſed, and declared, he knew not the cauſes of them, and left us his opinion of *them* in hints only, and queries, that ſo they might be farther inveſtigated and aſcertained by the enquiries of ſucceeding philoſophers—if, I ſay, all this could be made out to ſatisfaction, I would willingly hope the reader's favour might be regained, and the words *fair*, *candid*, and *impartial*, keep their place in my title. And if, after this, I could ſhew, that Mr. HUTCHINSON has made farther enquiries—that he has attempted from ſcripture and experiment to inveſtigate and aſcertain the cauſes of things—and that (if his ſcheme holds) he has even proved Sir ISAAC's conjectures concerning them to have been, as far as they went, true and right, I cannot but flatter myſelf it would entitle his books to a careful and attentive peruſal, the only requeſt that has ever been made for them, and which (though as one ſhould think ſo very reaſonable a one) they have not, as yet, been able to obtain. Let not the reader, from any preconceived opinions of his own, think what I attempt to make out wild and impoſſible; nor, out of any fond deſire of ſeeing it made out, perſuade himſelf I have done it, if I have not. Let him not on the one hand judge me before he hears me, nor on the other take any thing for granted for which there is not abundant evidence. I ſhould be glad if the learned, and philoſophers of all ranks and denominations, would do me the honour to make their remarks upon me, and ſcrutinize all I ſay to the utmoſt, ſo it be done without prejudice or animoſity. And I am bold to be thus open and ingenuous with the world, becauſe I have no bye deſigns or intereſts to ſerve. I write for truth; and it is exactly the ſame to me whether I am found in the right or wrong, ſo I can but any way conduce to the diſcovery and eſtabliſhment of it: to effect which, I know not of a more likely method than laying the poſitions and opinions of both parties fairly together. Had any able hand undertaken to do this with regard to thoſe of Sir ISAAC NEWTON and Mr. HUTCHINSON, I had not had the preſumption to have thought of it; but, as nobody has done it, nor have I heard of any one who has any intention of doing it, I have taken the liberty humbly to offer my poor endeavours towards it. I am not vain enough to imagine ſo great and glorious an end can be compaſſed by ſo mean an inſtrument as I am. All I deſire is, that as every thing is done, ſo it may be taken, for the beſt.

In order then to come at a knowlege of Sir ISAAC's real ſentiments and diſcoveries in philoſophy, it will be neceſſary to take a ſurvey of his writings which contain them, and the account he himſelf there gives of the deſign and intent of his undertaking.

* And as the title-page of every author, who knows what he is about, ſhould be a general key to all that follows in his book, we will, if the reader pleaſes, firſt take a view of that. Here we are preſented with the following words:—*Naturalis philoſophiæ principia mathematica—Mathematical principles of natural philoſophy.* This title has been thought, I know, by ſome to involve in it a contradiction, the principles of every ſcience being, as they conceive, in itſelf, and therefore not to be taken out of another quite different from it, as the ſcience of phy-

ſics undoubtedly is from that of mathematics. But a paſſage in the proœmium to the third book will ſhew, I think, in what ſenſe it was meant. For there, Sir ISAAC, foreſeeing that ſuch a miſtake might ariſe, from not duly attending to his meaning, takes care to guard us againſt it, by informing us, that the principles of philoſophy he gives us are *not philoſophical principles of philoſophy*, but *mathematical ones only*. *In libris precedentibus principia philoſophiæ tradidi, non tamen* philoſophica, *ſed* mathematica tantum. "In the preceding books I have laid down "*the principles of philoſophy*; principles, not "*philoſophical*, but *mathematical*." Meaning plainly, that his philoſophy was quite a different thing from what commonly went by that name—the ſcience of *phyſics*. His conſiſted in calculating the different ratios and proportions of the known and viſible effects of unknown and inviſible cauſes, not in aſſigning thoſe cauſes to the effects. It was *mathematical philoſophy*, but had nothing to do with *phyſics*. He illuſtrated and explained e. g. what he called *the phænomena of gravity*; i. e. he found by diligent obſervation and compariſon, that there was ſuch an effect as this conſtantly produced in nature according to certain laws, rules, and proportions; but what produced it, or what the manner of the *agency* was, he never pretended to ſhew. The truth of this will be demonſtrated from his own words in its proper place. I bring it here only as an exemplification of what I take to be contained and implied in his title. If I am wrong in this, I ſhall, with a great deal of pleaſure, make my acknowlegements to any one who ſhall trouble himſelf ſo far as to ſet me right.

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* N. B. The editions of Sir ISAAC's works made uſe of in the following pages are—That of his *Principia* printed at *Cambridge* in 1713, 2d edit. and his *Optics* 3d edit. *Lond.* 1721 To the former of which I ſhall ſubjoin Mr. MOTTE's tranſlation, for the benefit of the *Engliſh* reader.—The edition of Mr. HUTCHINSON's works referred to is the laſt in 12 vol.

Next to the title, let us look a little into the preface, which lets us farther into his deſign, and will, I think, be found much to our preſent purpoſe. This is taken up chiefly in ſhewing the manner in which geometry relates to mechanics, and to philoſophy. At the concluſion of that part of it, Sir ISAAC, ſpeaking of his work, ſays—* *Nos autem non artibus ſed philoſophiæ conſulentes, deque potentiis non manualibus ſed naturalibus ſcribentes, ea maxime tractamus, quæ ad gravitatem, levitatem, vim elaſticam, reſiſtentiam flui-*

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* The author's preface, p. 2d.

dorum & ejuſmodi vires ſeu attractivas ſeu impulſivas *ſpectant: &* ea propter, *hæc noſtra tanquam* philoſophiæ principia mathematica *proponimus*. "Our deſign not reſpecting "arts but philoſophy, and our ſubject, not "manual but natural powers, we conſider "chiefly thoſe things which relate to gravi- "ty, levity, elaſtic force, the reſiſtance of "fluids, and the like forces, *whether attrac- "tive or impulſive*. And *therefore* we offer "this work as *mathematical principles of phi- "loſophy*." This, I apprehend, greatly confirms the account I have above given, as it plainly declares, that the reaſon of their being ſtyled *mathematical principles of philoſophy* was, becauſe in them were conſidered, in a geometrical way, the *effects* called *gravity*, *levity*, *elaſticity*, &c. whether they were *cauſed* by *attraction* or *impulſe*—*ſeu attractivas ſeu impulſivas*. This therefore was not deſigned to be determined in this work, but the phænomena only and proportions laid down. And this philoſophy differed from mechanics, in that they treated only of *manual*, this of *natural* powers. Another ſentence in the ſame page deſerves particular regard—*Utinam cætera naturæ phænomena ex*

principiis mechanicis eodem argumentandi genere derivare liceret. Nam multa me movent *ut nonnihil ſuſpicer* ea omnia *ex* viribus quibuſdam *pendere poſſe, quibus corporum particulæ* per cauſas nondum cognitas *vel in ſe mutuo impelluntur & ſecundum figuras regulares cohærent, vel ab invicem fugantur et recedunt:* quibus viribus ignotis, philoſophi hactenus naturam fruſtra tentarunt. *Spero autem quod* vel huic *philoſophandi modo*, vel veriori alicui, *principia hic poſita lucem aliquam præbebunt.* "I wiſh we could derive "the reſt of the phænomena of nature by "the ſame kind of reaſoning from mechani-"cal principles. For I am induced by *many* "*reaſons* to ſuſpect that they may all depend "upon *certain forces* by which the particles "of bodies, *by ſome cauſes hitherto unknown*, "are either mutually impelled towards each "other, and cohere in regular figures, or are "repelled and recede from each other; "*which forces being unknown, philoſophers* "*have hitherto attempted the ſearch of nature* "*in vain.* But I hope the principles here "laid down will afford ſome light either to "*that*, or *ſome truer* method of philoſophy." —Can any thing be more juſt, or modeſtly ſpoken? * There are ſecondary cauſes or agents, he is very ſenſible, that do perform and carry on the operations of nature, though they have hitherto remained unknown, and their having done ſo has been the reaſon that our ſchemes of philoſophy have all fallen ſhort:—which is the very misfortune I have above proved that muſt always attend ſuch ſchemes. But he hopes, that whenever they come to be diſcovered by *this*, or any *better* method of philoſophizing, what he has laid down may be of ſervice. And of very great ſervice undoubtedly it may, though it be not in itſelf ſufficient for finding the agents, in illuſtrating and adjuſting them to particular effects, when found.

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* To the ſame purpoſe in his Optics, p. 369, ſpeaking of the phænomenon of a drop of oil between two glaſſes, he ſays,—"There are therefore AGENTS *in nature* able to "make the particles of bodies ſtick together by very "ſtrong attractions. And it is *the buſineſs of experimental* "*philoſophy to find them out.*" So again p. 365—"Now "if compound bodies are ſo very hard as we find ſome of "them to be, and yet are very porous, and conſiſt of parts "which are only laid together, the ſimple particles which "are void of pores, and were never yet divided, muſt be "much harder—And how ſuch very hard particles which "are only laid together, and touch only in a few points, "can ſtick together, and that ſo firmly as they do, *without* "*the aſſiſtance of* SOMETHING *which cauſes them to be at-* "*tracted or* PRESSED *towards one another, is very difficult to* "*conceive.*"

Matters appearing thus plain from the deſign, as laid down in the title and preface, let us take a ſhort view of the execution, in the work itſelf.—In the firſt definition, ſpeaking of the quantity of matter as ariſing from the denſity and magnitude together, he ſays, —*Et par eſt ratio corporum omnium, quæ* per cauſas quaſcunque *diverſimode condenſantur.* "The ſame thing is to be underſtood of all "bodies, that are by *any cauſes whatever* differently condenſed." Is not this plain, that he conſiders the ratios, proportions, &c. only in a geometrical way, let the cauſes be what they will? *Medii interea, ſi quod fuerit, interſtitia partium libere pervadentis*, hic nullam rationem habeo. "I *have no regard in* "*this place to a medium*, if any ſuch there is, "that freely pervades the interſtices between "the parts of bodies." This is a ſtill farther proof. For had he been ſettling cauſes, the exiſtence and agency of ſuch a medium would doubtleſs have been the firſt thing to be enquired after. For if there be a fluid diffuſed through nature, penetrating and permeating the pores of all bodies, no man in his ſenſes can deny that it muſt have a very great and principal ſhare in carrying on its operations. And that the—*ſi quod fuerit*—did not imply a diſbelief of any ſuch in Sir ISAAC—at leaſt, that he changed his mind marvellouſly afterwards, if it did—will be fully made to appear below.

The 5th definition is as follows:—*Vis centripeta eſt, quâ corpora verſus punctum aliquod tanquam ad centrum undique* trahuntur, impelluntur, vel utcunque tendunt. *Hujus generis eſt* gravitas, *quâ corpora tendunt ad centrum terræ*; vis magnetica, *quâ ferrum petit magnetem*; & vis illa, quæcunque ſit, *quâ planetæ perpetuo retrahuntur a motibus rectilineis, & in lineis curvis revolvi coguntur.* "A centripetal force is that by which bodies "are *drawn*, or *impelled*, or *any way tend* "towards a point, as to a centre. Of this "ſort is *gravity*, by which bodies tend to "the centre of the earth; *magnetiſm*, by "which iron tends to loadſtone; and *that* "*force, whatever it is*, by which the planets "are perpetually drawn aſide from the rec-"tilinear motions which otherwiſe they "would purſue, and made to revolve in

"curvi-

"curvilinear orbits." This likewiſe is abundantly plain. And that he thought the—*Vis illa quæcunque ſit*—that moved the planets, was contiguous and continuous from them to the ſun, I think is evident from his bringing (as he does in the next ſentence) the inſtance of a ſtone whirling round in a ſling, to illuſtrate it; as a body revolving in the air by a power connected with and joined to it can never, one would think, be an exemplification of one revolving by itſelf in empty ſpace without any ſuch power—I only propoſe it as a probable conjecture—Let the learned conſider, and determine. Towards the end of this definition, ſpeaking of the proportion of force neceſſary to retain the moon in her orbit, he ſaid—*Mathematicorum eſt invenire* vim, quâ corpus in dato quovis orbe datâ cum velocitate accurate retineri poſſit; & *viciſſim* invenire viam curvilineam, in quam corpus e dato quovis loco datâ cum velocitate egreſſum a datâ vi flectatur. Which is the true account of the uſe of mathematics, and agrees exactly with what I have above laid down concerning them; ſo that I have here the pleaſure and ſatisfaction to find, that I fight this battle with Sir Isaac

on my ſide; the ſenſe of the paſſage being plainly and evidently this—"That the buſi-
"neſs of mathematicians is to find out what
"quantity or proportion of force or power
"is neceſſary to keep a body in any given
"orbit with a given velocity, and on the
"other hand, to ſettle the orbit that a body,
"ſetting out from a given place with a given
"velocity, will by ſuch force be bent into."
But as to the cauſe of that force, whether it be within or without the body, whether lodged in fluids or ſolids, mathematics by no means ſettle, or have any thing to do with it.

In definition VIIIth he explains the meaning of the terms—*Vis centripeta*, *motrix*, *acceleratrix*, *attractio*, &c. at large, and ſpecifies particularly what ſenſe it is he uſes them in. I ſhall ſet the paſſage down at length, as it may be ſufficient to end all diſputes upon this point. *Haſce virium* quantitates brevitatis gratiâ *nominare licet vires motrices*, *acceleratrices*, & *abſolutas*; & diſtinctionis gratiâ *referre ad corpora*, *centrum petentia*, *ad corporum loca*, & *ad centrum virium*: *nimirum vim motricem ad corpus*, tanquam *conatum* & *propenſionem totius in centrum*, *ex*

propenſionibus omnium partium compoſitam; *& vim acceleratricem ad locum corporis*, tanquam *efficaciam quandam de centro per loca ſingula in circuitu diffuſam, ad movenda corpora quæ in ipſis ſunt*; *vim autem abſolutam ad centrum*, tanquam *cauſâ aliqua præditum, ſine quâ vires motrices non propagantur per regiones in circuitu*; ſive cauſa illa ſit corpus aliquod centrale *(quale eſt magnes in centro vis magneticæ, vel terra in centro vis gravitantis)* ſive ALIA ALIQUA QUÆ NON APPARET. MATHEMATICUS duntaxat eſt hic conceptus. Nam virium CAUSAS & ſedes PHYSICAS jam non expendo. "Theſe quan-"tities of forces we may, *for brevity's ſake*, "call by the names of motive, accelerative, "and abſolute forces; and, *for diſtinction's* "*ſake*, conſider them with reſpect to the "bodies that tend to the centre; to the "places of thoſe bodies; and to the centre "of force towards which they tend: that is "to ſay, I refer the motive force to the body, "*as* an endeavour and propenſity of the "whole towards a centre, ariſing from the "propenſities of the ſeveral parts taken to-"gether; the accelerative force to the place "of the body, *as* a certain power, or energy,

" diffuſed from the centre to all places " around to move the bodies that are in " them; and the abſolute force to the cen- " tre, *as* endued with ſome cauſe, without " which thoſe motive forces would not be " propagated through the ſpaces round about; " *whether that cauſe is ſome central body* " (ſuch as is the load-ſtone in the centre of " the force of magnetiſm, or the earth in the " centre of the gravitating force) *or any* " *thing elſe that does not yet appear.* For " I here deſign only to give a MATHEMATI- " CAL notion of thoſe *forces*, without conſi- " dering their PHYSICAL *cauſes* and *ſeats*." So again a little below—*Porro attractiones & impulſus eodem ſenſu* acceleratrices & motrices *nomino. Voces autem* attractionis, impulſûs, vel propenſionis cujuſcunque in centrum, indifferenter & pro ſe mutuo promiſcue uſurpo; *has vires* non PHYSICE, ſed MATHEMATICE tantum conſiderando. *Unde* CAVEAT LECTOR, *ne per hujuſmodi voces cogitet me* ſpeciem *vel* modum actionis CAUSAMVE aut rationem PHYSICAM alicubi definire *vel centris (quæ ſunt puncta mathematica) vires* VERE & PHYSICE tribuere, *ſi* FORTE *aut* centra trahere, *aut* vires centro-

rum *eſſe dixero.* " I likewiſe call attractions
" and impulſes in the *ſame ſenſe* accelerative
" and motive; and uſe the words attraction,
" impulſe, or propenſity of any ſort towards
" a centre, *promiſcuouſly*, and *indifferently*
" *one for another*; conſidering thoſe forces
" not PHYSICALLY, but MATHEMATICALLY:
" wherefore *the reader is not to* IMAGINE,
" that by thoſe words I *any where*
" take upon me to define the *kind* or the
" *manner* of any action, the CAUSES or the
" PHYSICAL *reaſon* thereof, or that I attribute
" FORCES in a TRUE and PHYSICAL ſenſe
" to certain centres (which are only mathematical
" points) when at any time I HAPPEN
" to ſpeak of centres *as attracting*, or
" *endued with attracting powers*."

To this definition give me leave to add another paſſage or two to the ſame effect. Lib. I. ſect. II. ad init. p. 147. *Jam pergo motum exponere corporum ſe mutuo trahentium, conſiderando vires centripetas* tanquam attractiones, *quamvis fortaſſe*, ſi PHYSICE loquamur, *verius dicantur* impulſus. *In* MATHEMATICIS *enim jam verſamur, & propterea,* miſſis diſputationibus PHYSICIS, *familiari utimur ſermone, quò poſſimus a lectoribus mathematicis*

thematicis facilius intelligi. "I ſhall at pre-"ſent go on to treat of the motion of bodies "mutually attracting each other; conſider-"ing the centripetal forces *as attractions*; "though perhaps *in a* PHYSICAL *ſtrictneſs* "they may more truly be called *impulſes*. "But theſe propoſitions are to be conſidered "as *purely* MATHEMATICAL; and therefore, "*laying aſide all* PHYSICAL *conſiderations*, I "make uſe of a *familiar way of ſpeaking*, to "make myſelf *the more eaſily underſtood by* "*a mathematical reader*." So again—ibid. ſchol. ad fin.—p. 172. *Vocem* attractionis *hic generaliter uſurpo pro corporum conatu* quocunque *accedendi ad invicem*, ſive *conatus iſte fiat ab* actione corporum, *vel ſe mutuo petentium*, *vel per ſpiritus immiſſos ſe invicem agitantium*, ſive *is ab* actione ætheris, aut aëris, mediive cujuſcunque ſeu corporei ſeu incorporei *oriatur*, *corpora* innatantia *in ſe invicem* utcunque impellentis. *Eodem ſenſu generali uſurpo vocem* impulſûs, *non* ſpecies virium & qualitates PHYSICAS *ſed* quantitates & proportiones MATHEMATICAS *in hoc tractatu expendens*, ut in definitionibus explicui. "I here uſe the word *attraction* in "general for *any endeavour* of *what kind* “*ſoever* made by bodies to approach each other, whether that endeavour ariſe from the action of the *bodies themſelves* as tending mutually to, or agitating each other by ſpirits emitted; or whether it ariſe from the action of the *æther*, or of the *air*, or of *any medium whatſoever, whether corporeal or incorporeal, any how impelling bodies placed therein towards each other.* In the ſame general ſenſe I uſe the word *impulſe*, not defining in this treatiſe the *ſpecies*, or PHYSICAL *qualities of forces*, but inveſtigating the *quantities and* MATHEMATICAL *proportions of them*; as I obſerved before in the definitions.”

In the *proœmium* to the third book, p. 356, he ſays—*In libris præcedentibus principia philoſophiæ tradidi*, non tamen PHILOSOPHICA ſed MATHEMATICA TANTUM, *ex quibus videlicet in rebus philoſophicis diſputari poſſit. Hæc ſunt motuum & virium* leges & conditiones, *quæ ad philoſophiam maxime ſpectant. Eadem tamen, ne ſterilia videantur, illuſtravi ſcholiis quibuſdam philoſophicis, ea tractans quæ generalia ſunt, & in quibus philoſophia maxime fundari videtur, uti* corporum denſitatem & reſiſtentiam, ſpatia corporibus vacua,

cua, motumque lucis & ſonorum. *Supereſt ut ex* iiſdem principiis *doceamus* conſtitutionem ſyſtematis mundani. " In the preceding " books I have laid down *the principles of* " *philoſophy*; principles *not* PHILOSOPHICAL " *but* MATHEMATICAL; ſuch to wit, as we " may build our reaſonings upon in philoſo- " phical enquiries. Theſe principles are " the *laws* and *conditions* of certain motions, " and powers, or forces, which chiefly have " reſpect to philoſophy. But leſt they ſhould " have appeared of themſelves dry and bar- " ren, I have illuſtrated them here and there, " with ſome philoſophical ſcholia, giving " an account of ſuch things as are of more " general nature, and which philoſophy ſeems " chiefly to be founded on; ſuch as the den- " ſity and the reſiſtance of bodies, ſpaces " void of all bodies, and the motion of light " and ſounds. It remains, that from the " ſame principles I now demonſtrate the " frame of the ſyſtem of the world." This exhibits at one view the ſcheme and nature of this celebrated work. The two firſt books are taken up in ſettling the laws, rules, and proportions of motion, and moving bodies, with ſome general philoſophical ſcholia touching the denſity and reſiſtance of bodies, ſpace void of bodies (*groſs* ones only I preſume) and the motion of light and ſounds; after which, in the third book, theſe laws, rules and proportions are applied to the phænomena of the ſyſtem of the univerſe. But that there is not the leaſt hint in that, or the former, concerning the *phyſical cauſes* of all or any of theſe motions, we have the author's own word for it, which (if we will believe him, and think he underſtood his own writings) ought for ever to determine the matter. P. 483. *Hactenus phænomena cælorum & maris noſtri per vim gravitatis expoſui, ſed* CAUSAM gravitatis NONDUM ASSIGNAVI.—*In hac philoſophia propoſitiones deducuntur ex phænomenis, & redduntur generales per inductionem.* Sic impenetrabilitas, mobilitas, & impetus corporum et LEGES motuum & gravitatis INNOTUERUNT. "Hitherto we have explained the phænomena "of the heavens and of our ſea by the "power of gravity, but *have not yet aſſigned* "*the* CAUSE *of this power.*—In this philoſophy particular propoſitions are inferred "from the phænomena, and afterwards rendered general by induction. Thus it was

" that the *impenetrability*, the *mobility*, and " the *impulſive force* of bodies, and the " LAWS of *motion* and of *gravitation* were " DISCOVERED." Here Sir ISAAC has enabled me to ſum up the whole of the queſtion I am upon, in a word. The LAWS, then, not the CAUSES of motion and gravity, are what he has *diſcovered.*

Thus I have faithfully laid before the reader ſuch a ſtate of philoſophy as I have found in Sir ISAAC. I have no authority to add any thing to him, or make him ſay what he does not. Phyſics are utterly diſclaimed all through his principia, of which, from the title to the concluſion, mathematics only are affirmed to be the ſubject; all cauſes are abſolutely and entirely ſet out of the queſtion, the terms explained to ſtand only for effects, and the reader expreſsly cautioned to take them in no other ſenſe, by that ever-to-be remembered CAVEAT LECTOR in the VIIIth definition. Words cannot poſſibly make any point clearer and plainer than this is made by Sir ISAAC.—But is it ſo, it may be aſked, with his *followers?* What ſhall we do with them? To which I anſwer, that I humbly think, there are enough of them to do for themſelves. And if they have done any thing they ſhould not have done, they will be ready, I dare ſay, when properly informed of it, to undo it again. I am not ſtating the caſe between NEWTONIANS and HUTCHINSONIANS, but NEWTON and HUTCHINSON; and if their reſpective admirers have celebrated either of them for excellencies which they never pretended to, and faſtened doctrines and poſitions upon them which they never dreamt of holding, nay, which they have denied and diſclaimed—that is no fault of mine. I am heartily ſorry for it, and muſt beg the favour of every man who has been guilty of it, to be as quick as he can in taking to himſelf his ſhare of the burden under which he has made his author in an awkward manner to ſidle and waddle, that the world may ſee him walk ſtraight and upright in his eaſy and natural gait, without which they can never be able to form a proper judgment of his ſhape. That the admirers of Sir ISAAC have done this, I take not upon me to affirm. But thus far, I hope, may be ſaid, without offence, that it muſt ſurely have been a little inadvertency, (to ſpeak in the gentleſt manner we can of it) in ſome of them, occaſioned, I doubt not, by their ſuperlative honour and veneration for his name, to beſtow ſuch extravagant encomiums upon him as they have done, and that ſo contrary to his own declarations, as a writer who had made ſuch amazing and ſtupendous *phyſical* diſcoveries into the *agency* of nature. And they ſhould have reflected, that praiſing him for what he had not done was the keeneſt piece of ſatire they could have thrown out againſt him, as it was ſlily and covertly objecting to him, what he ought to have done to have deſerved thoſe praiſes, and to have really been, what they ſay he is, —A PHILOSOPHER. This may perhaps be thought too forward and preſuming in me to ſay. And indeed, were it any thing new, or an obſervation purely of my own, I had not ventured upon it. But it is not. Sir ISAAC himſelf, in his life time, complained of being killed with the kindneſs of his friends, as it is left upon record by the learned and ingenious Dr. PEMBERTON, who in the laſt page of his *view*, ſpeaking of *attraction*, tells us—" He (Sir ISAAC) has often " complained to me of having been miſun" derſtood in this matter. What he ſays "upon this head was not intended by him "as a *philoſophical explanation* of any appearances, but only to point out a power "in nature not hitherto diſtinctly obſerved; "the cauſe of which, and the manner of its "acting, he thought was *worthy of a diligent enquiry*." If I might be allowed to offer a conjecture upon this occaſion, what it is that has been the cauſe of all the miſtakes that have ariſen concerning the NEWTONIAN ſyſtem, though Sir ISAAC had ſo well guarded againſt them, and of our foundering at the threſhold of his meaning, inſtead of proceeding, as we ſhould have done, and he deſired us to do, in our phyſical enquiries, I humbly think it has been owing to Sir ISAAC's uſing his terms in a different acceptation from what the words generally are taken in. For, as Dr. PEMBERTON very juſtly obſerves—* "the common inaccurate "ſenſe of words, notwithſtanding the limitations given them by definitions, will offer itſelf ſo conſtantly to the mind, as to "require great caution and circumſpection "for us not to be deceived thereby." E. g.

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* View—p. 9 at the bottom.

The word *attraction*. When an author ſays one body *attracts* another, it is natural enough, at firſt ſight, to underſtand him, as if he had ſaid, that one body *pulls another to it*, becauſe that is the primary ſenſe of the word *at-* or *ad-traho*. So in *repulſion*, or one body *driving another back from it*. All which *looks* like lodging the power in ſolids, and excluding the agency of a fluid medium. Whereas Sir ISAAC means them only as names for the phænomena of two bodies going together or retiring from each other, whatever be the cauſe of it.* Thus again in the uſe of *attraction* and *impulſe* as *ſynonymous* terms, without ſome attention it is very difficult to come at all at his meaning, thoſe two words, in the common acceptation of them, being as contrary as light and darkneſs; the one being, when two bodies draw or pull one another together by ſome internal virtue, the other, when they are driven together by ſome external force. But Sir ISAAC uſes them as marks or ſigns only to expreſs an effect, without deſining or ſettling by either of them what it is that produces it. So that in this caſe* the common ſenſe and meaning of the words are not to be regarded, or taken into the queſtion. The ſame may be ſaid of the word *vacuum*, which as it ſignifies *void*, or *empty*, has made many people imagine that by it Sir ISAAC meant to expreſs ſpace *void*, or *empty* of *all matter*, and aſſert that he held that abſurdeſt of all doctrines, an *abſolute vacuum* in nature. Whereas by a *vacuum* he meant only ſpace *filled* with a more fine and ſubtle matter, which, as it gave no ſenſible reſiſtance to bodies moving in it, was the ſame to appearance as if there really had been nothing. And in his Optics he has demonſtrated by experiment, that there is a ſubtle medium left in the ſmall *vacuum* of an exhauſted receiver, and hinted it as his opinion, that there is a fluid expanded thro' the larger one of the heavens.* Laſtly, to mention no more, thus it has fared with the word *infinite*, which Sir ISAAC uſed, doubtleſs, as ſynonymous with *indefinite*, to ſignify ſomething that could not be limited or bounded by us, not that was abſolutely without limits or bounds in itſelf. But ſome, fond of giving a looſe to a ſtrong and lively imagination, taking it in its ſtrict

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* Dr. CLARKE is very angry with Mr. LEIBNITZ for ſuppoſing any other— "It is very unreaſonable (ſays he) "to call *attraction* a *miracle*, and an *unphiloſophical term*; "after it has been ſo often diſtinctly declared, that by "that term we do not mean to expreſs the CAUSE *of bodies tending towards each other*, but *barely the* EFFECT, or "the PHÆNOMENON ITSELF, and the LAWS OR PROPORTIONS of that tendency; WHATEVER BE OR BE NOT THE "CAUSE OF IT." *Collection of Papers between* CLARKE *and* LEIBNITZ—p. 355.

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* However ſingular this method of uſing words abſtracted from their ideas may ſeem to thoſe who are unacquainted with the writings of philoſophers, we have the authority of Dr. WATTS for ſaying this is the caſe—"The moderns, when they uſe the words *gravitation*, *attraction*, &c. uſe them only to ſignify, that there are "ſuch effects and ſuch cauſes, with a frequent confeſſion "of their ignorance of the true ſprings of them: they "do not pretend to make *theſe words* ſtand for the *real* "*cauſes* of things, as tho' they thereby aſſigned the true "philoſophical ſolution of theſe difficulties; for in this "ſenſe they will ſtill be *words without ideas*, whether in "the mouth of an OLD philoſopher or a NEW one." *Uſe of Reaſon*, p. 87. edit. 8th.

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* "Is not this exterior heat conveyed *thro' the Vacuum* "by the vibrations of *a certain medium far more ſubtle than* "*air*, which medium, after the air was drawn out, *re*"*mained yet in the vacuum?*" Opt. p. 323. Does not this "medium readily pervade *all* bodies, and is it not by its "elaſtic force expanded thro' *the whole heavens?*" Ibid. p. 324.—That Sir ISAAC may not for the future be miſrepreſented, by thoſe who are determined at any rate to have an *abſolute vacuum* for their imagination to divert itſelf in, as if he thought the fluid ſo rare, as that there might ſtill be a very good vacuum left in the interſtices of the parts of it, it may not be amiſs to ſet down in this place his own account of its denſity.—Opt. p. 325. "If "this medium be rarer within the body of the ſun than "at its ſurface, and rarer at the *ſurface* than at the 100*th* "*part of an inch* from the body of the ſun, and rarer "there than at the 50*th part of an inch* from its body, and

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“ rarer at this laſt place than at the *orb of Saturn*, I ſee no
“ reaſon why the increaſe of its denſity ſhould ſtop *any*
“ *where*, and not rather be continued thro' *all the diſtances*
“ *from the Sun to Saturn and beyond*.” Now, tho' we ſuppoſe the fluid to be ever ſo rare at the Sun's orb, yet when it has received its degrees of denſity, increaſing in the manner here mentioned, thro' every inch from the Sun to Saturn, and from thence to the fixed ſtars, it cannot, I think, well be ſuppoſed capable of conſtituting any thing of a tolerable vacuum. Rather, it will be many times more denſe, than that denſe æther that was felt in *Egypt*. So that if, after all, we muſt have a vacuum, it muſt I believe be that deſcribed with ſo much livelineſs and ſtrength of imagination by the great Dr. YOUNG, in his *Night-thoughts*; where he ſuppoſes a perſon from a terrace, at the outbounds of the univerſe, looking over the wall of creation, and taking a ſurvey of Nothing's houſe and gardens in the valley of Non-entity—

———Say, LORENZO! Where,
Where, ends this mighty building? Where begin
The *ſuburbs of creation?* Where the wall
Whoſe battlements look o'er into the vale
Of NON-EXISTENCE? NOTHING'S *ſtrange abode!*

Night IXth. p. 367.

and proper ſenſe, and ſcorning to think of any thing leſs than infinite ſuns and worlds, have magnified the glory of God by contradicting his word, and proved themſelves good Chriſtians by turning atheiſts. For if the univerſe be infinite, it is moſt certainly uncreated; and if it be uncreated, it is as certainly God; unleſs there be either two uncreated infinites, or one infinite can create another. This unhappy miſunderſtanding of Sir ISAAC's terms ſeems indeed to have been the ſeed-plot of all our misfortunes. And I muſt confeſs, I could wiſh he had changed them for others, which might have expreſſed his meaning more clearly, and been leſs liable to miſtake. It had ſaved us many a bad and tireſome journey through the immaterial virtues and occult qualities of the ſchools, many a dark and uncouth voyage into the regions of infinite ſpace.

"BUT what?"—Some one will ſay—"and "muſt we then give up a *vacuum*, that baſis "of all philoſophy, and * barrier againſt "atheiſm?" To this I anſwer, I take not upon myſelf, neither indeed would it be-come me, to impoſe articles of faith in philoſophy, any more than theology, upon people, or tell them what they ſhould do. I only lay things before them as I find them, in the ſimpleſt and plaineſt manner I am able, and ſet not up for a dictator. But I ſhould imagine, that if we cannot keep the doctrine of a *vacuum*, the beſt way will be to part with it, as I know of no medium there is between keeping it and not keeping it. If any ſuch can be found out, I ſhall be glad to have it publicly propoſed, that it may be taken into the queſtion, and have its due weight allowed it, which I ſincerely promiſe it ſhall. " But is it poſſible then, that Sir " ISAAC, after all, ſhould not hold this doc- " trine ?" Let thoſe who underſtand his philoſophy better than I do determine. I have proved, and ſhall prove more fully below, that he held the oppoſite to it; and it can never certainly be the intereſt of his admirers, nor will he, I think, be much obliged to any one who ſhall undertake to prove that he did hold it; becauſe that would be proving that he held both ſides of the queſtion, which would be proving that he held neither; and that again would be proving that he held nothing at all. But as to all this, it is no concern of mine how the matter is determined. Let juſtice be done to all parties, and I deſire no more. My buſineſs is only to propoſe and adjuſt things in ſuch a manner, that they may be determined fairly and clearly. In order to do this in the preſent caſe between Sir ISAAC and his *improvers*, I ſhall lay down a very ſhort and eaſy alternative, which will take in and bring the whole to a deciſion at once.

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* An ingenious divine calls a vacuum, *the* SPONGE *of all atheiſtical ſyſtems.*

EITHER, then, Sir ISAAC uſes the terms *vacuum* and *infinite* in their abſolute and proper ſenſes, and aſſigns *gravitation*, *attraction*, &c. as *cauſes*, to the excluſion of a material fluid, or ſecondary agent under God—Or, he does not.

This alternative is eaſy, and it is no leſs fair. Now, therefore, let them take which ſide of it they will. If they take the firſt, a few unſerviceable conſequences may perhaps be drawn by his adverſaries. Some of theſe I ſhall here ſet down, not as what I myſelf draw, or think any objections, but as what, I ſay, may poſſibly be (indeed, as I am credibly informed, actually are) drawn, and looked upon by ſome to be ſo. I ſet them down therefore purely for the ſake of the friends of Sir ISAAC; that, if they, upon mature conſideration, reſolve upon holding the ſide of the queſtion I mention, they may provide themſelves in time with proper anſwers. And I think I could undertake to promiſe the public, from their candour and ingenuouſneſs, that they will not reſolve to hold it, till they have provided themſelves with ſuch.

AND firſt, it may be ſaid perhaps by his opponents, that he acts contrary to his own expreſs declaration and moſt ſolemn promiſe to the reader, that he would not conſider them as cauſes; which method of proceeding may not be thought ſo conſiſtent with the rules of what is called *moral honeſty*. His *deſign* likewiſe, and the *end* he might have to ſerve by ſuch a two-faced behaviour, muſt, in this caſe, be a little looked into.

SECONDLY, that his book is one continued quibble upon thoſe terms, which are all double-entendres; ſo that as faſt as he is beat out of one, he flies to the other, and when diſlodged from that, comes back to the firſt again. Mankind are led a perpetual dance from attraction to impulſe, and from impulſe to attraction; from a vacuum to a plenum; and from a plenum to a vacuum; from infinite to indefinite, and from indefinite to infinite; and his principia are phyſics, or no phyſics, juſt as occaſion ſerves. A conduct, in ſo great a man, they may think harder to account for than any phænomenon in nature.

THIRDLY, as his *phyſics* (if his admirers will ſtill inſiſt upon their being ſuch) are formed ſolely from the appearance of things, without any conſideration had of an inviſible, yet material, agent, they may be apt to inſinuate a cloſer connection between him and the clock-geometrician than might be agreeable.

FOURTHLY, they may think that Sir ISAAC's ſcheme, taken in this light, contradicts—Revelation; which aſſures us, that the celeſtial bodies are placed in and ſo moved by the *heavens*, which are compact and ſtrong as a *molten*

molten ſpeculum *—Reaſon; which informs us, that matter cannot act where it is not preſent, or any body move without a mover —Experiments of all ſorts; which ſhew us, that the power which moves bodies is not within, but without them—Common ſenſe; which intimates to us, that, if one body emits virtues or effluvia againſt another, they may drive it farther off, but can never pull it nearer in to it—And himſelf; who ſays, there may be a plenum of æther, and gravity and all other motion cauſed by impulſe of that æther †.

THESE are ſome of the objections which I am told Sir ISAAC's opponents have to make, if the firſt part of the alternative be taken. If they are grounded upon miſtake, and ſhall, upon examination, be found wanting, by the gentlemen who take this ſide of the queſtion, I muſt confeſs, I ſhall long impatiently to ſee an anſwer to them, which I know they will, without any heſitation, immediately favour us with. If the objections are juſt and true, the high opinion I entertain of them will not ſuffer me to imagine it poſſible for them to take this part. It can never be. Sir ISAAC has too much ſenſe to hold ſuch abſurd, ſuch monſtrous poſitions—too much honour to impoſe upon the world in ſo low and ſhuffling a manner: and they, I am ſure, have a higher regard for his name and character, than to charge him with doing ſo, if he has not done it. I will therefore in this caſe ſuppoſe, and I dare ſay the reader will very gladly ſuppoſe with me, that the ſecond part of the alternative is what theſe learned gentlemen will chooſe, viz.—that Sir ISAAC has always kept up to his promiſes and declarations—that he never deſigned, the words *vacuum* and *infinite* ſhould be taken in their ſtrict and proper ſenſe—never meant by *attraction*, *gravitation*, &c. to aſſign the *cauſes* in nature, or to exclude by them the agency of a fluid medium, which the Scriptures and all antiquity have ever aſſerted and maintained, nay which once *Aſia and all the world worſhipped.*

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* Gen. I. 17. Job XXXVII. 18.

† The doctrines of a *vacuum* and *attraction* are finely confuted and ridiculed by cardinal POLIGNAC in his ANTILUCRETIUS above cited, lib. II. 865, & ſeq. & lib. IV. 933. & ſeq. that great man having, I know not how, imbibed an unhappy prejudice that they were maintained by Sir ISAAC; nay, he ſeems to have looked upon them as the fundamentals of his philoſophy, and the eſſential points in which he differed from Mr. DESCARTES.—Much is it to be lamented, that a writer, who could ſo effectually overthrow an erroneous plan, had not a true one to propoſe in the room of it!

AND if this laſt be taken and allowed, and Sir ISAAC really never pretended or thought of any thing farther than illuſtrating actions and effects, leaving the agents to be diſcovered by ſucceeding philoſophers—how a concluſion ſhould be drawn from hence, that therefore the agents are not to be diſcovered, and an attempt to diſcover them is to be rejected with ſcorn and indignation, unheard and unexamined, is, I muſt confeſs, and ever will be to me, amongſt the inſcrutables; when Sir ISAAC, in the laſt ſentence of his preface, ſo ſtrongly inculcates and earneſtly petitions for a quite contrary method of proceeding in his readers and followers—*Ut omnia candide legantur, & defectus in materiâ tam difficili non tam reprehendantur, quam* novis lectorum conatibus inveſtigentur, & benigne ſuppleantur, ENIXE rogo—
" That every thing I have ſaid may be read
" with candour, and my deficiences in the
" execution of ſo difficult a taſk, inſtead of
" being

" being found fault with, ſupplied by the " *further ſearches* of my readers, is my " EARNEST requeſt"—When the learned Dr. PEMBERTON finiſhes his *View* with this juſt and very remarkable obſervation—" To " acquieſce in the explanation of an appear- " ance, by aſſerting it to be a *general power* " *of attraction*, is not to *improve our know-* " *lege in philoſophy*, but rather to *put a ſtop* " *to our further ſearch*"—And laſtly, when the great Dr. CLARKE, in his Controverſial Papers with Mr. LEIBNITZ, ſays—* " If Mr. " LEIBNITZ or any OTHER philoſopher can " explain theſe phænomena by the laws of " mechaniſm, far from meeting with any " *oppoſition*, he will receive the *thanks* of all " the learned world." Now, what if Mr. HUTCHINSON ſhould prove to be that OTHER philoſopher, and to have explained all the phænomena of the univerſe *by the laws of mechaniſm*, and that in ſuch a manner as that they will ſtand the teſt of every experiment and obſervation that has been made? I ſay not that he has done this. All I would be thought to mean is, that the field is certainly open for a diſquiſition of the nature and kind that his pretends to be; and ſo far is it from contradicting, oppoſing, or rendering Sir ISAAC's labours uſeleſs, that it is confirming and making the true uſe of them; it is doing what Dr. CLARKE and he wiſhed ſo much to ſee done—what he *earneſtly* requeſted his followers to do—not to ſtop at effects only, but to go on and inveſtigate the cauſes of them. Surely therefore, to hinder and prevent the examination of ſuch an attempt, and to diſcourage and forbid the making of any ſuch, muſt be contrary to the very intention and deſign of Sir ISAAC, and deſtroy all the benefits and advantages that might have accrued to the world from his obſervations and experiments upon the *phænomena* or effects of nature, which he made (if we will believe him) with no other view, than that when the agents which performed them came to be diſcovered, they might be applied to them, and mutually ſtrengthen and confirm each other. And, indeed, I have often thought, (tho' with a leſs ſanction than that of Sir ISAAC NEWTON I ſhould not in this age have dared to have ſaid it) that the making experiments, and calculating proportions, where no farther end is propoſed by it, and it produces nothing but a ſtupid admiration, is a very low and ſervile employment for a man of genius. It is degrading the philoſopher into the mechanic, and that the moſt uſeleſs and unprofitable of all mechanics. The wheelwright who can make a plough, and the huſbandman who knows how to uſe it, deſerve infinitely more of mankind, than he who ſpends his time in meaſuring the tail of a comet, only to ſurpriſe and terrify mankind with a formidable range of cyphers. I beg I may not be miſunderſtood in this, or thought to hint any thing to the diſcredit or diſadvantage of experimental philoſophy. Experiments are undoubtedly the ſure way of proving or diſproving any hypotheſis, and all hypotheſes ſhould be examined by them. But they ſhould neither be ſtopt at without proceeding farther; for then they are little better than a raree-ſhew, and we ſhall never come at any cauſes: nor ſhould they be wholly relied upon without ſome better guide; for then we ſhall come at none but falſe ones: and that for this plain reaſon, becauſe the true and real agent in nature is ſo extremely fine and ſubtle, as to elude both ſenſe and experiment, ſo that they can never diſcover it to us, tho', when we have been told of it, its operations may be demonſtrated by them. The candid reader will give what is ſaid here its due weight, and not haſtily and inconſiderately (as thoſe who are attached to any particular ſcheme are ſometimes apt to do) accuſe me of taking away the uſe of experiments, when I would only have their abuſe rectified.

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* *Collection of Papers between* CLARKE *and* LEIBNITZ, p. 369.

So juſt and equitable does it appear then, from an examination of Sir ISAAC NEWTON's principia, that Mr. HUTCHINSON's claim ſhould be admitted, and his cauſe heard. But this is not all. I ſhall now beg leave to proceed one ſtep farther. For tho' Sir ISAAC, all thro' his *Principia*, treats of gravity, &c, as *effects* only; yet in the laſt ſentence of that book, and in the queries ſubjoined to his Optics,* "he has given

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* PEMBERTON's View, p. 22. The whole paſſage is worth notice—"Sir ISAAC NEWTON has found reaſon to "conclude, that gravity is a property univerſally belong- "ing to all the perceptible bodies in the univerſe, and to "every particle of matter whereof they are compoſed. "But yet he no where aſſerts this property to be eſſential "to

" ſome hints worthy of himſelf at a *cauſe* " for them." And what is that cauſe? Why, the very ſame that Mr. HUTCHINSON has aſſigned, with this difference only, that what Sir ISAAC could do no more than *conjecture* to be the agent, its true nature and manner of agency being, * as he confeſſed, wholly unknown to him, Mr. HUTCHINSON's deſign is to *demonſtrate* to be ſo, and explain its nature and manner of agency from the Bible compared with nature. This, I doubt not, will appear to many to be a ſtrange aſſertion, made at random, and without book. I ſhall offer my reaſons why I think ſo, which when the reader has conſidered, he muſt be left to form his own judgment upon the matter.

Sir ISAAC's opinion in general concerning the great agent in nature I ſhall give in the words of Dr. PEMBERTON. *View, p.* 376,

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" to matter. And he was ſo far from having any deſign " of eſtabliſhing it as ſuch, that, on the contrary, he has " given ſome hints worthy of himſelf at a cauſe for it; " and expreſsly ſays, that he propoſed thoſe hints, to ſhew " that he had no ſuch intention. See at the end of " his Optics, in qu. 21. and the ſame treatiſe in advertiſement 2."

* Opt. p. 326. " For I *do not know what this æther is.*"

ſpeaking of the action of light, he ſays—"What the power in nature is, whereby this "action between light and bodies is cauſed, "our author has not *diſcovered*—He has in "general *hinted* his *opinion* concerning it; "that probably it is owing to ſome very ſubtle and elaſtic ſubſtance diffuſed thro' the "univerſe—He is of opinion, that ſuch a ſubſtance may produce this, and other effects "alſo in nature, tho' it be ſo rare as not to "give any ſenſible reſiſtance to bodies in "motion; and therefore not inconſiſtent with "what has been ſaid above, that the planets "move in ſpaces free from reſiſtance." An univerſal fluid then, we ſee, is the grand cauſe and agent, in Sir ISAAC's opinion, but ſuch an one as might not obſtruct the planets and other bodies moving in it, and all the *vacuum* he meant was *a ſubtle and elaſtic ſubſtance, readily pervading all bodies, and expanded thro' the whole heavens*, as himſelf expreſſes it—*Opt*. p. 324. This Mr. HUTCHINSON has undertaken to demonſtrate the reality of—to ſhew from ſcripture and nature, that the earth and planets are placed in *the heavens*, which are ſuch a fluid, and that ſo far is it from being any hindrance to their motion,

tion, that it is the cauſe and producer of it, the impulſe behind being mechanically contrived to be always greater than the reſiſtance before the moving body; which, if it can once be fairly made out, and clearly explained, I humbly think, anſwers all the objections that can poſſibly be raiſed againſt motion in a plenum. For the great difficulty in this caſe (if I apprehend the matter right) has been, that, tho' we ſuppoſe the fluid which conſtitutes this plenum to be in itſelf ever ſo rare, yet when a ſufficient quantity of it is amaſſed together to conſtitute one, it muſt afford a very great and ſenſible reſiſtance to ſolids ſwimming in it, according to the PSEUDO-NEWTONIAN plan, *by forces diſtinct from the impulſe of the fluid itſelf*; which, 'tis preſumed, would clog and impede, and finally put a ſtop to their motion. But if, according to Sir ISAAC's pure and unadulterated ſentiments concerning cauſes, the impulſe of the fluid be itſelf the cauſe of the body's motion, (as will be ſhewn below) the caſe is widely different. And then, if it can be proved, that the parts of this fluid plenum are by a conſtant circulation continually changing places with each other, and by that means thoſe which lie on one ſide a body made rarer, or conſiſting of particles of a ſmaller ſize than thoſe which lie on the other, nothing can be more eaſily conceived or accounted for, than the motion of a body in ſuch circumſtances towards that part where the fluid is rarer. The denſe fluid behind puſhing hard againſt it would impel it forwards, the rarer fluid before receding by the ſides and thro' the pores of it. There would be no need of the leaſt portion of *vacuum*, either for the ſolid or fluid to move into. The ſolid wants no more than its own ſpace, which it always carries with it, and the parts of the fluid only ſhift their ſtations with reſpect to one another, which they do inſtantaneouſly within as well as without the body, one particle taking the place of another exactly as that other leaves it, without any time or ſpace intervening. I hope I have expreſſed myſelf clearly upon this point, and muſt beg the reader's ſerious and attentive conſideration of it, as it is a very important one, and a proper examination and diſcuſſion of it may greatly conduce to a final determination of that firſt and grand article in all philoſophy, the phyſical cauſe and continuation of motion in this material ſyſtem.

THAT the power of *gravity* itſelf ſhould be owing to ſuch a *medium* as this we have been ſpeaking of, Sir ISAAC, Dr. PEMBERTON tells us* in another place, thinks it not impoſſible. And in his Optics, p. 325, he has hinted at the manner in which it may be performed, viz. by the medium being "rarer at the denſe "bodies of the ſun, ſtars, planets, and comets, "than in the celeſtial ſpaces between them;" ſo that, "if the elaſtic force of this medium "be exceeding great, it may ſuffice to impel "bodies from the denſer parts of the medium "towards the rarer, with all that force, or "impulſe, which we call gravity."† All this likewiſe Mr. HUTCHINSON has endeavoured fully to prove; to ſhew, that this medium is rareſt at the ſun, where, for that reaſon, there is a continual preſſing in of the denſer parts from the circumference of the heavens; that there is likewiſe a rarefaction conſtantly and ſucceſſively cauſed by the heat of the ſun at the ſurface of the earth and planets, which gives an opportunity for the denſe parts pouring in thither as conſtantly and ſucceſſively to impel and force them forwards in a circle round the ſun, turning them at the ſame time on their own axes.* Theſe, he ſays, are the true powers and agents in nature, all her operations depending upon this one plain and ſimple principle, that whenever any part of the medium is rareſied, or made ſiner than the reſt *, the adjacent denſe and more groſs ones ruſh in, to ſupply and fill it up, and reduce all to an equilibrium again, carrying with them any thing that happens to be in their way. And were I to offer a conjecture upon the origin of attraction among the ancients, it ſhould be this —They attributed the motion of a body towards any rarefied part of the medium: e. g. the ſun, to a power in that part, which ſeemed to ſuck and draw it to itſelf, as not ſeeing the impulſive power behind, which drove it to that part, only becauſe there was leaſt reſiſtance there. Sir ISAAC, we ſee, has very happily diſcarded this erroneous notion, and reſtored the true power *impulſe* again— "The fluid, ſays he, *may ſuffice to* IMPEL *bodies with all that force or* IMPULSE *which we call gravity.*" A circumſtance well meriting the attention of all philoſophers, upon more accounts than one: ſince, if the fluid acts by impulſe from one end of the heavens to the other, from the *ſun* to *the orb*

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* Page 406.

† "If Dr. PEMBERTON from this would ſtrike *attraction*, "*gravity*, &c. out of Sir ISAAC NEWTON's books, and put "in *impulſe by æther*, they would in many places be true." HUTCH. vol. v. p. 272.

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* The reader may perhaps obtain a more ſatisfactory idea of the manner of this operation than I can give him, from a well known electrical experiment, ſhewn by the ingenious Mr. RACKSTROW, in Fleet-ſtreet—A large copper globe being placed in the centre, and a ſmaller one of glaſs in a circular groove at ſome diſtance from it, the electrical ſtream conveyed to the central globe irradiates from thence againſt that hemiſphere of the ſmall glaſs one turned towards it, as the light from the ſun does againſt the earth, and planets; and produces exactly the ſame effect, the glaſs globe being cauſed by it to revolve upon its own axis round the copper one—What it is that moves the planets, cannot after this, I think, be diſputed by any reaſonable perſon. And if the ſun, by the ſtream of matter it ſends forth, be the agent that gives the earth its motion (as the copper globe does the glaſs one) then did not JOSHUA ſpeak in a manner ſtrictly *philoſophical*, when he bade the *one* ceaſe its action, which of courſe ſtopt the *other*?

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* This principle of the denſe parts of the fluid preſſing in to the rarer is explained and made great uſe of by the writers upon the cauſe and origin of *winds*—HALLEY, &c.

of SATURN and the *fixed ſtars*, muſt not all the parts of it be in the cloſeſt contact? Otherwiſe could they impel each other? And then, if there was but a cubic foot of void ſpace in the ſyſtem, as there is ſuch a ſtreſs and preſſure upon all the parts of it, muſt not contact and impulſe ceaſe, and all fall into confuſion, as an arch does when one of the ſtones that compoſe it is withdrawn? And if ſo, muſt we not upon the *true* NEWTONIAN principles bid that long miſtaken and much loved notion of a *vacuum*, interſtitial as well as abſolute, finally farewell, and find out ſome other SPONGE for *atheiſtical ſyſtems?*—The ſkilful in phyſics will give us their opinions—I proceed.

THAT the ſame fluid, with which the heavens are filled, and the earth and planets moved, is the cauſe of all the other operations of nature, Sir ISAAC declares it as his opinion, in the concluding ſentence of his Principia. *Adjicere jam liceret nonnulla de* ſpiritu quodam ſubtiliſſimo *corpora craſſa* pervadente, & in iiſdem latente; *cujus vi & actionibus particulæ corporum ad minimas diſtantias ſe mutuo* attrahunt, *& contiguæ factæ* cohærent; *& corpora* electrica *agunt ad diſtantias*

tantias majores, tam repellendo quam attrahendo *corpuſcula vicina*; & lux emittitur, reflectitur, refringitur, & inflectitur, & *corpora* calefacit; & ſenſatio omnis excitatur, & membra animalium ad voluntatem moventur, *vibrationibus ſcilicet* hujus ſpiritûs *per ſolida nervorum capillamenta ab externis ſenſuum organis ad cerebrum & a cerebro in muſculos propagatis. Sed hæc paucis exponi non poſſunt*; *neque adeſt* ſufficiens copia experimentorum, *quibus leges actionum hujus ſpiritûs* accurate *determinari & monſtrari debent*. "And now we might add ſomething "concerning a certain *moſt ſubtle ſpirit*, "which *pervades* and *lies hid* in all groſs bo-"dies; by the force and action of which "ſpirit, the particles of bodies mutually *at-"tract* one another at near diſtances, and *co-"here* if contiguous; and *electric* bodies "operate to greater diſtances, as well *repel-"ling* as *attracting* the neighbouring cor-"puſcles; and *light* is *emitted*, *reflected*, *re-"fracted*, *inflected*, and *heats* bodies; and *all "ſenſation* is excited, and *the members of "animal bodies move at the command of the "will*, namely, by the vibrations of *this ſpi-"rit*, mutually propagated along the ſolid fi-

" laments of the nerves, from the outward " organs of ſenſe to the brain, and from the " brain into the muſcles. But theſe are " things that cannot be explained in few " words, nor are we furniſhed with that " *ſufficiency of experiments*, which is required " to an *accurate* determination and demon- " ſtration of the laws by which this electric " and elaſtic ſpirit operates." Mr. HUTCHINSON has treated of this *moſt ſubtle ſpirit* at large, and by his obſervations, made with infinite care and diligence upon different parts of nature, has procured *a ſufficient number of experiments* of all kinds, as he thinks, fully and accurately to aſcertain the laws of its action, tho' Sir ISAAC at that time could not, for want of ſuch. That it is, as Sir ISAAC ſays, a *moſt ſubtle ſpirit, pervading and lying hid in all groſs bodies*—that it is the cauſe of *attraction* of all kinds, *electricity*, the *emiſſion* and all the operations of *light*, and *heat* the effect of light, the reader may ſee perhaps put beyond all diſpute in Mr. HUTCHINSON's ſecond and eleventh volumes, as the deſign of the tenth is to demonſtrate to any impartial perſon, that it is the grand agent in the *human frame*, producing the *circulation* of the blood, and all *ſenſation*, and *muſcular motion*.

HITHERTO, I think, there is little jarring or diſcord between our two philoſophers. The only remaining point is the nature and ſubſtance of this agent, in whoſe exiſtence and operations we are ſo well agreed. Here Mr. HUTCHINSON was very ſenſible, as indeed every body elſe is, that human ſcience has always fallen ſhort; all the ſchemes, framed to account for the cauſe and continuation of its motion and agency, have proved abortive; *ſuch knowlege is too excellent for* man's wiſdom, and a long, long experience has taught us, he *cannot*, by his own ſtrength, *attain unto it*. Mr. HUTCHINSON therefore conſidering this, and at the ſame time reflecting upon the reaſon of it, that the principal part of this heavenly fluid lies far above out of our ſight, and is not by any means to be come at by us, thought there was but one way in the world by which we could poſſibly arrive at the knowlege of it, viz. by examining, with humility and diligence, what account was given of it in the Bible, where its creation and formation were deſcribed at large by him who created and formed it.

For it is very remarkable, that in the hiſtory, *the heavens* are put firſt; and for good reaſon, ſince, as it is ſaid elſewhere, GOD has* *ſet their dominion in the earth*, and appointed them to rule over it, and all its productions. They would have had but a ſorry claim to this pre-eminence, had they been nothing but *empty ſpace*, a thouſand miles ſquare of which is not equivalent to a cubic inch of matter, not to mention the ſtrange idea the words—*In the beginning God created empty ſpace*—convey to the mind, if indeed they convey any. From the account of this fluid in the firſt chapter of Geneſis, compared with other places of ſcripture, Mr. HUTCHINSON thought he had diſcovered, that it exiſted in three conditions, FIRE, LIGHT, and groſs AIR, or SPIRIT—that the AIR continually preſſing in from the circumference of the heavens, to ſupply and fill up the rarefaction made by the FIRE at the ſun's orb, was there as continually itſelf rarefied, refined, and ſent forth every way in form of LIGHT, till by degrees, as it got farther off, it was condenſed and concreted into AIR, and returned again to nouriſh the FIRE, a conſtant ſtreſs and preſſure being by this means laid on the parts of itſelf, and every thing in this material ſyſtem included in it; and that the action in a culinary fire, ſupported in the ſame manner, exhibited a picture of it in miniature to us, ſo that, by experiments upon that, the other might be clearly explained and illuſtrated *. All this is

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* Job XXXVII. 33.

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* It falls not within the compaſs of my preſent deſign to give any farther account of the SS. philoſophy as explained by Mr. HUTCHINSON, than is neceſſary in ſtating the caſe between him and Sir ISAAC. A clear, regular, and well digeſted ſyſtem of the whole, with the proofs and illuſtrations of each part (a thing much and long wanted) will I hope be laid before the public, by ſome one equal to the taſk; for the reception of which, if this imperfect ſketch of things may ſerve in any meaſure to prepare the way, by removing ſome groundleſs prejudices that have obtained, with regard to Sir ISAAC NEWTON, the author will think himſelf amply rewarded for his pains, whatever ſentence the world may otherwiſe pleaſe to paſs upon him and it. He would not indeed diſoblige the world, if it could be honeſtly avoided, but he will never oblige it at the expenſe of truth. A reſolution, which in theſe times it may be thought not quite ſo *prudent* to make: but he has this encouragement to it, which he begs leave likewiſe to recommend to the conſideration of others, that he, who enters the liſt in the cauſe

is looked upon as quite new, and peculiar to Mr. HUTCHINSON, and great clamours are raiſed againſt it. But what ſays Sir ISAAC? Why, under his ſecond rule, "that like effects are to be aſcribed to like cauſes," he tells us, as an inſtance of it, and a thing univerſally known and allowed, that "the *light* of a *culinary fire* and of the *ſun* have *the ſame manner of production* *." If, therefore, the *light* of a *culinary fire* be produced by a rarefaction of the *air*, of which there is always a draught to it, this will at once prove Mr. HUTCHINSON's whole plan upon Sir ISAAC NEWTON's principles. And that the light and heat of a culinary fire are owing to the *air* Sir ISAAC himſelf is expreſs, when, ſpeaking of the atmoſphere of the ſun, he ſays, *Opt.* p. 319. "The ſame great weight may condenſe thoſe vapours and exhalations as ſoon as they ſhall at any time begin to aſcend from the ſun, and make them preſently fall back again

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cauſe of TRUTH (not *truth in the abſtract*, but the TRUTH of GOD in CHRIST, as revealed in the BIBLE) fights under him, who bears inſcribed on his banner—I HAVE OVERCOME THE WORLD.

* [illegible] *Princip.* lib. III. reg. II. p. 357. Pemb. p. 24.

"into him, and by that action increaſe his "heat much after the manner that in our "earth *the air increaſes the heat of a culinary fire.*" How can this be? How can *cold* air increaſe the *heat* of fire? But Sir ISAAC NEWTON ſays it does; moſt undoubtedly then it does it by changing its condition from *cold* to *hot*, i. e. by going in in the form of *air*, which, as it is ſo denſe as not to pervade the pores, cauſes the ſenſation of *cold*, and coming out in that of* *light*, which, as it is finer, and can pervade them, cauſes that of *heat*. Whether Sir ISAAC, by the *atmoſphere preſſing upon the ſun*, intended that immenſe fluid in ſcripture called *the heavens*, part of which is continually going to, and part receding from the centre, I take not upon me to determine: thus much, however, may certainly be inferred from it, that he was very ſenſible there wanted a vaſt preſſure upon every part of the ſun's orb, to prevent the fire from diſſipating and ſcattering the parts of it, as well as ſome kind or other of *pabulum*, to feed and nouriſh that fire, and ſupply the place of the light ſent off from thence every moment in ſuch quantities and diffuſed quaquaverſum throughout the world *.

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* That there may be no diſpute raiſed about the word *light*, the reader will not think it impertinent in me to ſtop him, only while I inform him, that I here uſe that word for that ſubtle fluid which proceeds continually from the ſun and our culinary, and other focuſes upon earth, whether it be viſible or not; ſince it is notorious by experiment, that this great and glorious agent in nature exerts itſelf with great force and vigour in its other manifold operations, when, for reaſons obvious enough to the philoſopher, it does not affect the eye in that particular manner which produces the ſenſation of viſion.

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* There is a paſſage in his Optics, in which he ſeems to have had a notion, that the heavens were filled with *two* agents, counteracting each other, as Mr. HUTCHINSON ſuppoſes the light and air to do, tho' he was greatly at a loſs how to conceive the manner of their operation. P. 339. "It is as difficult to explain by theſe hypotheſes, "how rays can be alternately in fits of eaſy reflexion and "eaſy tranſmiſſion; unleſs perhaps one might ſuppoſe "that there are in *all ſpace* TWO *ethereal vibrating mediums*, and that the vibrations of one of them conſtitute "light, and the vibrations of the other are ſwifter, and "as often as they overtake the vibrations of the firſt, put "them into thoſe fits. But how *two* æthers can be diffuſed thro' all ſpace, one of which *acts upon the other*, "and by conſequence is *re-acted upon*, without retarding, "ſhattering, diſperſing, and confounding one another's "motions, is inconceivable." Had this great man only conſidered his own inſtance of a culinary fire a little cloſer,

and

I have now laid before the reader the proofs for the points I undertook to make out—that phyſics and mathematics were ſciences eſſentially different, the end of the one being to inveſtigate cauſes, the province of the other to aſcertain effects—That Sir ISAAC NEWTON's Principia were entirely converſant upon the latter, and that what he offered occaſionally concerning the former was propoſed under the form of conjectures and queries only, given as hints for future philoſophers to proceed upon, and enquire farther into—After which I have likewiſe endeavoured to ſhew in brief, that Mr. HUTCHINSON has enquired farther into them, and (if his ſcheme holds) even demonſtrated thoſe conjectures to have been, as far as they went, true and right. In do-

and obſerved how the *action* and *re-action* of the air going in and the light coming out were ſo far from *retarding*, *ſhattering*, *diſperſing*, *and confounding one another's motions*, that they were the very means of preſerving them, and then applied this to the ſun and the two æthers in the heavens, he had ſucceeded in cauſes as well as effects, and had been perhaps the greateſt philoſopher in the world. But ſince we cannot have this from a NEWTON, why ſhould we diſdain to take it from a HUTCHINSON?—Let the ſerious and unprejudiced lay this to heart.

ing this I have made the extracts faithfully, and I hope reaſoned fairly upon them when made. The reader will now indulge me in one reflection upon the whole.

How unreaſonable a thing then is it, and how deſtructive has it always proved to the cauſe of truth, to take a prejudice either for or againſt a thing, without having conſulted and weighed the evidence by which it is ſupported! We have an inſtance of both theſe in the caſe before us. In the firſt place, the prejudice for Sir ISAAC has been ſo great that it has deſtroyed the intent of his undertaking, and his books have been made a means of hindering that knowlege which they were intended to promote. It is a notion every child imbibes almoſt with his mother's milk, that Sir ISAAC NEWTON has carried *philoſophy* to the higheſt pitch it is capable of being carried, and eſtabliſhed a ſyſtem of *phyſics* upon the ſolid baſis of *mathematical demonſtration*. This is taken for granted, and grows up with us as a firſt principle, nor is there one in ten thouſand that ever examines his writings to ſee whether it really is ſo or not. The natural conſequence of this is, that if any author publiſhes farther diſcoveries which are ſuppoſed to differ from Sir ISAAC, be his pretences ever ſo plauſible and ſpecious, he is not allowed a hearing. But now when Sir ISAAC's writings come to be peruſed, we find all this to be a vulgar error. Nothing, as it ſhould ſeem, was ever leſs in his thoughts, than demonſtrating the *phyſical cauſes* of nature by the *mathematics.* He owns an entire ignorance of them, and for that reaſon throws all he has to offer concerning them into *queries* only, *earneſtly* deſiring thoſe who come after to enquire farther, and make a proper uſe of his experiments upon phænomena, towards ſettling what it is that produces them. On the other hand, the tide of prejudice runs as high now againſt Mr. HUTCHINSON. He is repreſented as a violent enemy to mathematical demonſtration, and a broacher of new and enthuſiaſtic whims never heard of before, in oppoſition to Sir ISAAC NEWTON and the whole world. This paſſes as current and univerſal as the other, and with juſt the ſame reaſon; for it is amazing to think how few there are, amongſt thoſe who are the loudeſt againſt him, that have ever read his books, or know what he ſays upon any one ſubject. For did they but examine into the merits of the cauſe, they would ſee, that, inſtead of being an enemy to mathematical demonſtration, few people had a greater regard for the mathematics, in their proper place, tho' he might blame others for putting them in one for which they never were deſigned; and it was a conſtant rule he obſerved himſelf, and a conſtant piece of advice he gave to others, never to *believe* without proper *evidence*. And as to the charge of *whim* and *novelty*, it is the laſt one ſhould have expected to have heard: I mean with regard to his philoſophy; for as to his * theology, it is not before me now.

His

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* I cannot but wiſh this little rude attempt of mine upon the philoſophy, may give a hint to ſome abler head and pen, to lay before the world a ſtate of that matter likewiſe. A proper diſtinction might then be made between thoſe things in Mr. HUTCHINSON's writings which are *really* new and of his own manufacture, and thoſe which are only *thought* to be ſo. The former muſt be received, or rejected, as they ſhall, upon a ſtrict ſcrutiny and examination, be found to deſerve; but thoſe which were ſufficiently proved and eſtabliſhed in former ages, muſt ſtill continue ſo, notwithſtanding the uſe he may chance to make of them. Whereas, upon the preſent

plan

His opinion, that there is a ſubtle agent, which performs the operations of nature, has been univerſally held, by all philoſophers from THALES to Sir ISAAC NEWTON, (none diſputing the being of ſuch an agent, but whether it were divine or material;) and tho' it has been ſometimes thought he rejected it, and did the buſineſs without, yet from his own words I think it has been demonſtrated, that he looked upon it as abſolutely neceſſary to explain and account for the phænomena of the univerſe, and left it to be enquired after, as the main-ſpring of all philoſophy. Its ſubſtance, mechaniſm, and mode of acting indeed puzzled them all. And this Mr. HUTCHINSON has only endeavoured to ſhew from the Bible, as well as to prove that the Scripture account has the

plan of condemning indiſcriminately, and at a venture, all he ſays upon every ſubject, we may be in danger, amidſt that variety he handles, of having ſome of the greateſt and moſt important articles of our faith, held by the church of CHRIST in all ages from ADAM to the preſent times, denied, becauſe Mr. HUTCHINSON maintains them, and the *foundation* overſet, by too furiouſly and precipitately throwing down the *ſtubble* it is ſuppoſed (and will it not be taken amiſs, if I add, *only* ſuppoſed) he has built upon it.

collateral evidence of all antiquity, (as far as the imperfect knowlege they retained of things went), and is demonſtrated by every experiment that has been made by the moderns. I muſt confeſs I cannot conceive how a more noble attempt could have been made, or a more rational method invented of making it. And that it ſhould not be examined, or looked into, when made, would be altogether unaccountable, did not Mr. MACLAURIN inform us, the caſe was exactly the ſame with the great Sir ISAAC NEWTON himſelf, when his books firſt appeared in the world. The reader would not think it poſſible ſo inveterate and obſtinate a prejudice as he tells us of, ſhould once be general againſt an author, who has ſince been ſo well received and approved. I will therefore take my leave of him by ſetting down the paſſage at length for his ſatisfaction and amuſement. It is in the 13th page—

" IT was no new thing that this philoſo-
" phy ſhould meet with oppoſition. All the
" uſeful diſcoveries that were made in
" former times, and particularly in the laſt
" century, had to ſtruggle with the preju-
" dices of thoſe who had accuſtomed them-
" ſelves,

" ſelves not ſo much as to think, but in a
" certain ſyſtematic way; who could not
" be prevailed on to abandon their favourite
" ſchemes, while they were able to imagine
" the leaſt pretext for continuing the diſpute:
" every art and talent was diſplayed
" to ſupport their falling cauſe; no aid ſeemed
" foreign to them that could in any manner
" annoy their adverſary; and ſuch often
" was their obſtinacy, that truth was
" able to make little progreſs, 'till they were
" ſucceeded by younger perſons who had
" not ſo ſtrongly imbibed their prejudices."

FINIS.

In the Preſs, and ſpeedily will be publiſhed,

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⁂ It is intended alſo to print a new Edition, in 8vo. of Conſiderations on the Life and Death of ST. JOHN the BAPTIST, originally publiſhed in 1772, and reprinted in 1777 (thoſe Editions being out of Print) together with ſome MS. SERMONS, and other Pieces in Divinity, by Dr. HORNE, never publiſhed before; which will be printed on the ſame Size with the Sermons, Life, &c. &c. agreeably to the Wiſh of many Admirers of the Biſhop's Writings, that they may be in Poſſeſſion of an uniform Edition of his Lordſhip's Works.

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